Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal

Section 1. General administrative information

Produce watershed analysis procedure for salmon habitat restoration

Bonneville project number, if an ongoing project 9142

Business name of agency, institution or organization requesting funding
Columbia River Inter-Tribal Fish Commission

Business acronym (if appropriate) CRITFC

Proposal contact person or principal investigator:

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name

NPPC Program Measure Number(s) which this project addresses.
Sections 6.4 and 6.5

NMFS Biological Opinion Number(s) which this project addresses.

Other planning document references.

NPPC and BPA (1997)
Shurts (1997)
Annual Implementation Work Plan, draft 6/3/97
National Academy of Science, "Upstream," (1996)
USDA and USDI (1994)

Subbasin.

N/A

Short description.

Create a standardized design and methodology for watershed analyses specifically oriented toward salmon restoration project development.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
x	Anadromous fish		Construction	x	Watershed
	Resident fish		O & M		Biodiversity/genetics
	Wildlife	x	Production		Population dynamics
	Oceans/estuaries		Research	x	Ecosystems
	Climate	x	Monitoring/eval.		Flow/survival
	Other	x	Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.

habitat restoration projects, watershed analysis, land management

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Develop standardized procedure and format for watershed analysis	a	Literature search.
		b	Experimental design and model for proposed framework
		c	Write draft
		d	Review draft
		e	Submit final report and distribute

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	10/1999	02/2001	100

Schedule constraints.

Completion date.
September 30, 2000

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel	.6, .4 FTE Scientists, 1.0 FTE Technician	77000
Fringe benefits	31.5%	24255
Supplies, materials, non-expendable property		3300
Operations & maintenance		0
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		0
PIT tags	# of tags:	0
Travel		4200
Indirect costs	36.9%	40131
Subcontracts		0
Other		0

TOTAL		148886

Outyear costs

Outyear costs	**FY2000**	**FY01**	**FY02**	**FY03**
Total budget	62036			
O&M as % of total	0			

Section 6. Abstract

We propose to produce a standardized process and format for watershed analyses specifically designed for evaluation and review of salmon habitat restoration projects. This proposed study is a response to management concerns that watershed analyses be performed and should be made available prior to evaluation of potential habitat restoration projects. However, although many watershed analysis formats and designs do now exist, it is unclear which ones (or parts) are the best to use and what are the best ways to incorporate them into the habitat restoration project review process. This study will consider a variety of key issues that, if not addressed, will result in a process that is inconsistent, confusing, and, in some cases, unnecessarily burdensome, while at the same time, yielding questionable results that have marginal utility for evaluating projects or identifying restoration needs. We will review literature and available tools and guidelines, and consider such issues as: the appropriate scale of analysis; a flexibility of design and linkage of analysis to project type; consideration of intra- and interbasin consistencies in scope and quality; what are the most efficient methods to characterize relevant ecosystem conditions; and how to guide project selection during any interim period while watershed analyses may be in preparation. Study results will determine the most effective format(s) for project deliverables. Possible options could include a written report, a written template, a flow chart scheme, a computer-guided program, and/or a graphical matrix. Time required to complete the proposed project is one year and two months and the proposed cost is $148,886.

Section 7. Project description

a. Technical and/or scientific background.

i. Problem statement

The requirement that a watershed analysis be prepared before undertaking restoration treatments in a stream is both logical and well intended management procedure. However, there is very little guidance available on what the analysis itself should include and how it should be conducted and presented. There are numerous formats, frameworks, and methods available in the literature for conducting these studies. Many designs are very complex and expensive and time consuming, while others are simply vague and trivial. Most are oriented to forest land and logging management and not towards salmon restoration. If the burden for production of a watershed analysis should fall to a project

proposer, he/she may be incapable of performing such an analysis that could prove far more complex than the restoration project in question. Overall, these uncertainties may well produce an institutional and bureaucratic management requirement rather than a scientifically useful methodology. Requiring these analyses could ultimately delay restoration efforts rather than guide them more efficiently.

The need for a guidance document or procedure for conducting watershed analysis can be seen frequently in proposals such as those that recommend placing large woody debris in streams to create pool habitat that have dominant fine sediment transport problems or high water temperature due to riparian shade loss. It is also evident in proposals to rip-rap banks to improve streambank stability and improve habitat complexity and species diversity. These examples highlight the probable utility of developing a watershed analysis procedure that incorporates a tiered approach related to project type. It may be that certain types of projects would not require comprehensive watershed analysis, using all components, parameters, or modules.

Projects vary in their consistency with the NPPC fish habitat goals, the goals of the tribal recovery plan (Wy-Kan-Ush-Mi Wa-Kish-Wit), the goals expressed in FEMAT, PACFISH, or ICBEMP, or state recovery goals. In addition, some projects that may be worthwhile under certain circumstances may be fruitless when applied toward restoration goals given the overall status of a watershed or stream system. Projects also may in certain cases need to be tailored to the specific type of stream reach or riparian zone being restored. The ecological or geomorphic context of the project site often must be explained for one to interpret whether proposed restoration techniques will be useful. The effectiveness of a project relative to current condition, ecological context, and stated restoration endpoint may be a function of the habitat factor that is most limiting. Although analysis of limiting factors may be useful for assessing effectiveness of any single proposed restoration action, restoration may be a function of multiple factors on the project site or within the environment of the site. In order to carefully evaluate the utility of a proposed project, it would be necessary to apply a more holistic view to sustainable fish habitat conditions that goes beyond the traditional narrowly focused limiting factor approach. Such an approach would consider a site within a hierarchical framework. In this context, restoration would be a function of management of the site, its immediate environment, and the watershed as a whole.

Project habitat objectives are frequently stated in terms of management objective, desired future condition, reference site condition, proper functioning condition, biodiversity, habitat diversity, habitat or water quality standards, range of natural variability, or other concepts related to desired restoration endpoints. Development of a project proposal typically depends upon explanations of the current condition of a site relative to its desired state or range of states. In order for a restoration proposal to be effectively evaluated, there must be a means to evaluate the significance of the current condition, the reasonableness of the target endpoint, and the likelihood that the restoration techniques would result in progress toward achieving the stated goals.

We believe a standardized design and methodology for watershed analyses

specifically oriented toward salmon restoration actions would be of great benefit to the region. Benefits of such a methodology and procedure include:

1. Allowing evaluation of goals and priorities for restoration efforts in a particular river or stream within a watershed context.
2. Guiding watershed restoration treatments to areas of highest need, or at least establishing those areas of need for management consideration.
3. Standardizing procedures to match regional scope of project review process and creating consistency in analysis among and within subbasins.
4. Clarifying minimum expectations for proposers as well as a logical framework with which project reviewers can judge the need for a proposed project.
5. Establishing a simple yet useful procedure, creating efficiencies for the conduct of watershed analyses and development of restoration projects, and speeding project review and decision making.
6. Linking project monitoring and evaluation to prior watershed analysis data and monitoring.

ii. Background history

The needs to manage salmon habitat using a watershed approach and to conduct watershed analysis as a precursor to designing habitat restoration projects have been key issues underlying many of the significant agency documents dealing with salmon habitat restoration in the Columbia Basin. The 1994 Fish and Wildlife Program emphasizes a watershed approach to habitat protection and improvement (Section 6.5, p. 6-45). Comprehensive watershed management is a planning process that allows coordination of goals and objectives, identification of information gaps and priority activities. Activities on federal and private lands must be coordinated and consistent to achieve comprehensive watershed management (Section 6.5, p. 6-46) and this coordination is expected to result in identification of restoration projects. Maintaining and improving salmon habitat is reliant on coordination of all activities within a subbasin (Section 6.4, p. 6-39). Due to the widespread degradation of habitat quality and loss in habitat quantity, there is an urgent need for comprehensive watershed management (Section 6.4, p. 6-40). The Council has a set of habitat objectives (Section 6.4C, p. 6-42 to 6-43) for salmon habitat quality and seeks restoration projects and planning and also land management actions that are consistent with achieving these objectives (Section 6.4B, p. 6-41; Section 6.6A p. 6-48 to 6-49). Key habitat parameters identified by the Council include sediment, water temperature, large woody debris, large pools, and water quality (Appendix B). Restoration actions funded should be those that have a high probability of success at a reasonable cost (Section 6.4B, p. 6-41). In model watershed development, the Council emphasizes identification of key limiting factors to salmon productivity (Section 6.5B, p. 6-48 to 6-49).

The NPPC recommendation concerning the need for watershed assessment was clearly expressed in the Shurts (1997, p. 18). Council recommendations state:

> Watershed assessments should precede implementation of further restoration activities in each subbasin or watershed, perhaps with the possibility of limited

case-by-case exceptions. Habitat projects have often been selected on the basis of opportunity rather than on the basis of whether the selected projects address the habitat and population needs in the relevant watershed. The watershed assessments should allow for better understanding of the needs of each watershed and how projects relate to those needs and thus will better allow for prioritization of projects within each subbasin.

The CBFWA Watershed Technical Work Group integrated technical criteria for project proposals state that "for watershed assessment projects, the proposal should specifically describe reliable and widely accepted methodologies for developing watershed assessments that are applicable to the problem and that incorporate wide public, agency, tribal and private landowner involvement" (NPPC and BPA, file AWP98/h20shed/crteria5.wpd, Appendix 3). The Integrated CBFWA Caucus Criteria (NPPC and BPA, file AWP98/h20shed/crteria5.wpd, Appendix 4) states that the proposed project should have a watershed assessment that exhibits an understanding of ecological relationships among watershed processes, functions, and biota; identifies status of key elements of the watershed, target species, habitat refuges, key habitats, key restoration opportunities, risks to ecological function and connectivity. It is stated that this analysis should consist of first gathering and analyzing available information to develop a comprehensive understanding of the watershed. The watershed assessment must include a biological and physical monitoring and evaluation plan to assess long-term trends and variability and to determine whether the project promotes normative ecosystem processes (NPPC and BPA, file AWP98/h20shed/crteria5.wpd, Appendix 4).

A shift has occurred in the conceptual foundation of the fish production system of the Columbia River (AIWP, draft 6/3/97). With the 1994 Fish and Wildlife Program's call for creation of an independent scientific group and that group's proposed conceptual foundation, expressed in Return to the River, there is currently an emphasis on managing the Columbia River and tributaries as a natural-cultural system. Restoration is viewed as a process of understanding normative physical processes linked to development of productive habitat, healthy, sustainable fish populations, and high connectivity, complexity, and diversity of habitats. Goals, objectives, and strategies for restoration would come from this conceptual foundation. Objectives can be formed in terms of specific fish responses (numbers, diversity, survival, production) or as habitat physical conditions. Watershed restoration strategies are proposed measures to achieve fish, riparian, upland, or watershed objectives. Fish and wildlife managers have recommended identifying watersheds with high potential. Base habitat data was identified for all subbasins and also for indicator watersheds to allow monitoring of trends in stock productivity and habitat quality. Intensive data that was called for includes water temperature, discharge, substrate sediment, bank stability, channel morphology, large woody debris, pool frequency, riparian condition, macroinvertebrate community, and watershed/channel functional relationships. The programmatic framework calls for project sponsors to develop proposed actions and also to monitor implementation and effectiveness of individual projects.

The National Academy of Science publication "Upstream" (1996) pointed to the potential utility of watershed analysis as a landscape-scale evaluation of resource condition and risk assessment applied to 4th to 6th order stream networks. It is a process for identifying habitat restoration opportunities on geographic scales in this size range. Watershed analysis might lead to better environmental protection by devising appropriate management prescriptions than would occur under standard forest practices rules. However, it is unclear whether this will result in a more comprehensive approach to habitat restoration and protection. The success of this approach is reliant on an effective monitoring program. However, the watershed analysis procedures used in Washington do not require this. Watershed analysis involves assessment of the spatial and temporal aspects to watershed and habitat condition and character, and to environmental behavior. Watershed analysis involves gathering inventory information to improve understanding of these spatial and temporal patterns, infer cause-effect relationships, and to reveal patterns of cumulative effects on fish habitat. Watershed analysis is useful when planning restoration on a specific stream reach and also on an entire stream network (NAS 1996).

iii. Scientific literature review

A federal guide was established in 1995 for conducting watershed analysis (Regional Ecosystem Office 1995). These procedures were adopted by the USGS, USACE, USEPA, USFWS, National Park Service, BIA, USBLM, USFS, NMFS, NRCS, and NBS. This federal guidance produced a six-step process at the watershed scale applied to each of seven core topics that involves (1) characterization of the watershed, (2) identification of key issues, (3) description of current conditions, (4) description of reference conditions, (5) synthesis and interpretation of information, and (6) recommendations. The federal guide is meant to be applied at the watershed or subwatershed scale but is not designed for drainage or site-specific assessments not for river basin or subbasin assessments. A goal of watershed analysis is an understanding of the components of the ecosystem, processes operating in the ecosystem, and interconnections between systems. Fish habitat is a product of features such as the class of habitat, sediment transport processes, etc. The objectives in conducting each individual analysis determine the type of watershed analysis needed, but it is recommended in the federal system that all six steps be performed. Also, each analysis should consider the basic ecological processes, conditions, and interactions operating. A basic understanding of the watershed, its processes, and linkages is expected to be achieved by consideration of seven core topics: dominant erosion processes, dominant hydrology, vegetation (communities, seral stages), stream channel morphology, water quality conditions and trends, species (abundance, distribution) and habitats (condition and trend), and major human uses in various parts of the watershed. Although most ecological characteristics of importance may be captured within these broad categories, the amorphous guidance provided by this document permits a high degree of inconsistency among projects of a certain type, among watersheds or subbasins, and also does not explicitly provide flexibility that may be needed when designing an analysis to satisfy particular project requirements.

In the State of Washington watershed analysis has been used for several years in developing forest practices plans on state and private lands. The watershed analysis

process is an attempt to develop information on sensitive portions of the watershed, interpret linkages among parts of the watershed or processes, assess risks, develop land management prescriptions, make predictions about management actions, and improve BMPs on a site-specific basis on the basis of monitoring. The watershed analysis process attempts to interpret linkages from hillslope to stream in terms of sediment, water, large woody debris, and energy. Watershed processes include erosional processes, hydrology (peak and low flows), and riparian functions (LWD recruitment, shading, and bank stability). Inputs to the channel from these three main categories of processes are size fractions of sediment particles, water flow statistics during high and low flow periods, LWD channel obstructions, and water temperature. Resources at risk include fish habitat, water supplies, and engineered structures (e.g., roads, bridges, etc.). Cumulative effects can be managed by applying watershed analysis on a watershed basis by accounting for multiple impacts distributed across the watershed in areas of varying levels of sensitivity and also distributed in time. Impacts are assessed within separate modules for analysis, including mass wasting, surface erosion, hydrology, riparian condition, stream channel, fish habitat, water quality, water supply, and routing. Within modules, sensitivity of the land surfaces to changes in rates of various processes due to land management and sensitivity of fish habitat condition to altered processes are examined as a precursor to development of management prescriptions.

Despite the good contribution to the field of watershed analysis provided by the Washington watershed analysis system, there are numerous deficiencies that need to be remedied to improve its utility in providing forest practices prescriptions and managing cumulative forestry effects. Further, this process would need to be adapted for use on non-forest land and to apply to restoration planning (Collins and Pess 1997). The Washington Forest Practices Board (WFPB) method does not deal effectively with accumulated effects from multiple sources of impact. These kinds of impacts can be more complex than simply additive in nature. Although prescriptions are written after considering a watershed analysis, there is typically no scientific rationale provided for any prescription produced. Further, despite the experimental nature of prescriptions, there is seldom monitoring done to determine whether the watershed analysis process or the prescriptions were effective. The WFPB procedure has no means to evaluate effects of historic land management vs. current land management. The entire watershed analysis process is based upon the assumption that by applying a modified land management in sensitive land areas and standard forest practices in sensitive areas that cumulative effects will be controlled. This framework for cumulative effects is most likely severely flawed. The methodology does not incorporate a means to identify restoration targets. It is assumed that simply doing incremental improvements in land management will be effective at a landscape scale. The WFPB procedure also does not use a hierarchical framework for analysis that would embed any individual watershed analysis in a larger ecological context. This presents a major flaw when managing salmon, having a large geographic range. The WFPB process is in need of a means to identify restoration goals and historic productive capacity (Collins and Pess 1997).

Numerous other references are available that provide examples of watershed analyses that have been done (Bach 1995), summaries and compilations of procedures used by

agencies for cumulative effects analysis (Euphrat and Warkentin 1994), conceptual proposals for managing entire watersheds (Stanford et al. 1995, Lestelle and Mobrand 1995, Mobrand Biometrics 1996), manuals for conducting watershed assessment (GWEB 1997), directories to watershed councils and their projects (MacDonald 1996), and guidance on monitoring plans and parameters (USEPA 1996, USEPA 1997). Development of a watershed analysis framework will benefit from review and incorporation of concepts and methodology from other watershed management plans (Oregon Plan for coho management) and monitoring procedures (McCullough and Espinosa 1996).

iv. Linkage of proposed project to conceptual framework or model

The need for watershed analysis is recognized by most entities involved in review of project proposals. However, at present the adequacy of a watershed analysis for any kind of project remains in the realm of "I'll know a good analysis when I see it." The document proposed here would be an initial attempt to set bounds on what is minimally acceptable on an individual project basis relative to what should be expected from a more comprehensive, general purpose watershed analysis suitable for planning at the subbasin level. What is needed at various spatial scales probably varies considerably and the type of watershed analysis needed may have to vary with geographic scale as well as type of restoration project. Unless directions are provided that make clear the minimum expectations in watershed analysis, there is a high probability that poor projects could be justified in basins having abundant data and data analysis available or that worthwhile projects would be rejected in basins where data is scarce. In addition, if a comprehensive watershed analysis were required for the watersheds upstream of all projects, there would be a great burden applied to all projects on large river reaches or large watersheds in contrast to projects in small watersheds. Guidance to appropriate levels of analysis would provide a measure of fairness in requirements for analysis, would improve efficiency and economy by not requiring or encouraging unwarranted data gathering and analysis requirements, and also would make clear the kinds of information and interpretation that should certainly be present at a minimum. Development of guidance on conducting watershed analysis would be faced with balancing short-term needs for analysis vs. long-term planning needs at subbasin scales, large vs. small geographic scale management, the desire for ecosystem, holistic management and detailed limiting factors and cumulative effects analysis vs. the individual project, reach, and immediate environment.

b. Proposal objectives.

1. Produce a standardized procedure and format for conducting watershed analysis for application to salmon-bearing streams and watershed restoration under the Fish and Wildlife Program. This procedure will provide explicit direction on minimum requirements for the watershed analysis that is being called for as a precursor to submission of project proposals for restoration funding. Such a procedure will provide the conceptual framework for analysis and summary of relevant ecosystem character, appropriate level of intensity that is matched to types of projects, parameters, guidance to methods, and a review and evaluation of concepts and assumptions leading to creation of

desired restoration endpoints. A watershed analysis process has the potential to guide resources into those areas in a specific sub-basin or tributary where biological need is greatest and where efficiencies could be maximized. It may also give project review teams a much clearer understanding and an efficient tool for evaluating proposals of different types within a watershed or subbasin or among subbasins.

c. Rationale and significance to Regional Programs.

The Fish and Wildlife Program is oriented to habitat improvement conducted on a watershed basis (6.5). The role of watershed analysis procedures has been highlighted as a needed precursor to development of an effective habitat restoration proposal (National Academy Press 1996, Shurts 1997, CBFWA 1998), yet there has been little guidance available concerning appropriate methods, sufficiency of data availability and interpretation, and what kinds of habitat parameters are required for a meaningful analysis. It is generally agreed that some sort of watershed analysis is required, but it is important that this requirement does not become merely a meaningless exercise to complete in satisfying proposal requirements, nor does it become an extremely burdensome process that thwarts reasonable restoration projects. There are numerous formats, frameworks, and procedures available for conducting watershed analyses, yet these procedures vary from extremely labor intensive and excessively complex, to vague or trivial. Most procedures are not specifically directed to restoration or salmon but are oriented to forest land management and logging. Overall, the uncertainties concerning what constitutes a watershed analysis may well produce an institutional and bureaucratic management requirement rather than a scientifically useful methodology. Requiring these analyses could ultimately delay restoration efforts rather than guide them more efficiently.

Presently, anyone attempting to develop a restoration proposal is faced with providing evidence that a watershed analysis is available. This requirement might be considered to be met by presenting some data that are readily available on the watershed in question. It becomes the responsibility of the proponent to gather and analyze available data or to do original field data collection. Data collected previously for some particular inventory or monitoring project may or may not be especially suited to watershed analysis needs. But it is not so clear what would constitute a satisfactory watershed analysis. Certain types of restoration actions may be fairly non-controversial and require minimal watershed analysis, whereas other proposed actions may need more extensive analysis. Project proponents do not have the time or responsibility to review all watershed analysis procedures, synthesize these methods, and devise a framework and select methods uniquely suited to the type of restoration action. They should not be expected to second-guess what might be required, nor should they be allowed to select just any readily available data, ID team discussions, or off-the-shelf watershed analysis method. Proponents should also be protected from improperly assuming heavy burdens of watershed analysis to precede restoration actions. Minimum expectations should be made extremely clear.

The need for the work proposed here can be most easily highlighted by itemizing some common scenarios that are typical in proposal development:

a) It is unclear what is really expected in doing a watershed analysis. A local watershed council has collected some data and subbasin plans are available. If this is presented in our proposal, this probably will suffice.
b) A watershed analysis is required prior to submitting a restoration proposal. The USFS does a lot of watershed analyses and they typically cost about $1 million apiece. The Washington watershed analysis procedure has modules for doing many different types of resource inventories and the manual is approximately two inches thick. It seems like my proposal should be unquestionably effective in restoring fish habitat. How much watershed analysis is really needed to justify my project?
c) It is a huge burden to have to become a watershed analysis expert or read all the available manuals just to be able to submit a restoration project. On the other hand, to simply be able to pull off the shelf some sort of analysis for a watershed, done in a generic way, that geographically incorporates a project stream reach may not provide relevant details to the proposed project.
d) Is would be most convenient to just pick the shortest watershed analysis method. The REO (1996) framework is brief and very general. This should be the quickest way to meet the requirement because the project proponent can select just about any available parameter falling into the categories listed.
e) With dozens of parameters that could be measured in many different categories (e.g., vegetation, hydrology, channel morphology, etc.) and with each watershed analysis method using various combinations of parameters and methods, how can someone devise a useful watershed analysis process? If each project proponent uses a different method, how can the utility of projects be compared among one another?
f) The utility and rationale for the project depend upon the restoration endpoints selected and those may vary radically from project to project. There would appear to be a lack of consistency among projects in the types of watershed analysis methodologies used but also in the restoration goals. How large a discrepancy might exist among projects proposed as high priority for a basin when there may be a large variation in expected recovery endpoints (basin recovery potential, process capabilities, expectations of ecological condition) among project proponents. The rate of progress made toward achieving a restoration endpoint depends partially upon the restoration measure selected, the ecological context for the site restoration (limiting factors, management framework, the watershed character and condition), and the reasonableness of the assumed endpoint.

This proposal is to produce documents that will provide (1) a framework for conducting watershed analysis that will be synthesized from the principal literature available on watershed analysis, ecosystem management, systems ecology, ecological monitoring, and contacts with resource management professionals. This literature will be directed to meet the needs of salmon habitat restoration; be suitable for restoration on forest land, rangeland, and agricultural land; (2) an evaluation of means for adjusting watershed analysis to the kinds of projects proposed, geographic scale of the project and watershed or subbasin, (3) a guide and recommendations to the kinds of parameters, methods for collecting data, and means for summarizing watershed and

in-channel habitat parameters, and (4) a review of assumptions and monitoring methods for establishing restoration endpoints and measuring trends in habitat condition.

d. Project history

N/A. This is a new project proposal, not dependent upon previous projects or ongoing projects.

e. Methods.

This project will entail collection of literature relevant to watershed analysis, ecosystem management, monitoring, watershed and stream restoration, ecosystem modeling, and evaluation of restoration endpoints. It will be necessary to thoroughly read, summarize, condense, evaluate, contrast and compare, and most importantly to synthesize a process that is of ultimate utility for use in the Columbia Basin to evaluate habitat restoration proposals for salmon habitat. It will be important to communicate with agency personnel involved in conducting watershed analyses to become informed on recent methods and procedures. In addition to the previously mentioned literature, it will be important to evaluate the types of habitat proposals that have been submitted and other commonly used practices so that guidance can be generated concerning the scope of watershed analysis that would be required.

i. Tasks identified for objective.

a. Literature and information review. Evaluate available literature for conducting watershed analyses, ecosystem management, ecosystem monitoring, etc. that is relevant for synthesizing a watershed analysis procedure and framework suitable for application to the Columbia Basin, salmon habitat, forest, range and agricultural lands, and restoration projects. Highlight the conceptual bases and applications of available systems. This document will aid a project proponent in navigating among the numerous formats for watershed analysis.

b. Experimental design and model for proposed framework
b1. Develop and evaluate a procedure for selecting a level of watershed analysis sufficient to meet the needs of the project. Currently, there is no guidance available concerning the intensity of analysis needed to satisfy the needs of a project proposal. There are numerous watershed analysis methodologies available. However, these methods are general in nature, not necessarily geared toward watershed restoration or fish habitat conservation and restoration. They vary from general in scope and vague in methodology (REO 1995) to elaborate (WFPB 1993) in methods but lacking in terms of level of analysis appropriate for various kinds of projects. Provide guidance on the extent (degree of comprehensiveness) of watershed analysis needed for site-specific to broad geographic scale projects. Such guidance is needed in the interest of balancing short-term needs in the Columbia Basin for identifying and justifying needed restoration projects and long-term planning needs in which comprehensive watershed analysis would

be needed at the subbasin scale. A framework for satisfying watershed analysis needs on these spatial and temporal scales will be developed.

b2. Provide recommendations for key information needs relevant to watershed analysis for various kinds of projects (site specific to larger geographic scale), recommendations for the methods for collection of data, and suitable methods for summarizing watershed and fish habitat condition and the linkages between a restoration site and its effective controlling environment. In proposing a watershed or stream restoration project it may be important in justifying the utility of certain types of projects to explain the linkages between the condition of the watershed, hillslope, riparian zone, wetland, streambank, and in-channel habitat condition. A restoration project proposal might explain its utility in terms of a summary of the aggregate condition of the project site, possibly the outer environment of the site, and the linkages between the site and its environment.

b3. Review and evaluate the conceptual basis that various management agencies or resource professionals have used for identifying restoration goals. This task would also involve comparing the management or restoration scenarios that might be linked to differing habitat goal setting procedures, and evaluating whether different projects, monitoring methods, or watershed analyses would be called for given the different goals.

c. write draft

d. review

e. submit final report and distribute

f. Facilities and equipment.

The office at Columbia River Inter-Tribal Fish Commission, 729 NE Oregon St., Suite 200, Portland, OR would be used for this work. Equipment needed for this work is primarily a computer and word processor. We will also make use of the StreamNet library, housed at the same address, which has capabilities for searching published journal literature, much agency gray literature, and can request needed information by inter-library loan. Our phone and internet/e-mail facilities are adequate for communication and data transfer from agencies.

g. References.

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USEPA (US Environmental Protection Agency). 1996. The volunteer monitor's guide to quality assurance project plans. USEPA, Office of Wetlands, Oceans and Watersheds, EPA 841-B-96-003. September 1996.

Washington Forest Practices Board. 1993. Board manual: Standard methodology for conducting watershed analysis under Chapter 222-22 WAC. Version 2.0, October 1993.

Section 8. Relationships to other projects

This project proposal is related to another project being submitted for 1999 funding by Drew Parkin, PSMFC, dealing with Data Services to Watershed Projects. This project would facilitate availability and exchange of habitat data, analysis of such data, and provide regional summaries of habitat conditions and restoration projects being conducted (e.g., mapping of actions relative to conditions). Otherwise, this project is not dependent upon or known to be related to any other project. However, when completed, it would have utility to all habitat restoration project proponents in development of their projects. It would aid in evaluating restoration endpoints, conducting an appropriately scaled watershed analysis, would aid in selection of parameters and methods, assist in developing relevant limiting factor analyses, and help raise in relief those habitat issues of highest priority. By providing a simple, concise, and clear set of procedures for watershed analysis, it would increase efficiency in formulating project proposals. For project reviewers this document will assist by providing a minimum level of expectations for various kinds of restoration activities. It will eliminate much of the subjectivity in evaluating whether a sufficient watershed has been completed.

Section 9. Key personnel

Dale A. McCullough, Managing Fishery Scientist, Columbia River Inter-Tribal Fish Commission (CRITFC), Project FTE: 0.6. Project Duties: Co-project leader, coordination, technical analysis, report writing. Education: B.S. Zoology, Ohio University, Athens, Ohio, 1970; M.S. Biology, Idaho State University, Pocatello, Idaho, 1975; Ph.D. Fisheries, Oregon State University, Corvallis, Oregon 1988. Certification status: None. Current Employer: CRITFC (9/85-present). Current Responsibilities: Act as supervisor for fish production/habitat team; duties include project planning and coordination, preparation of workplans and budgets, personnel reviews and other assorted personnel matters. Technical responsibilities include analysis of direct and cumulative effects of land-use on salmon habitat, channel morphology, water quality, and watershed processes; linkages between habitat conditions and fish survival, growth, and ecology. Provide scientific input in technical committees dealing with fish habitat, monitoring, and water quality issues. Recent Previous Employment: Research assistant, 3/1978-5/1982, Department of Fisheries and Wildlife, Oregon State University. Development of a system and methodology for classification of watersheds and streams. Computer analyst, Anadromous, Inc., Corvallis, OR. 9/1984- 9/1985. Statistical analysis of coded wire tag data for salmon returns to aquaculture company. Research assistant, 7/1983- 9/1985, College of Oceanography, Oregon State University. Radiochemical analyses of marine and river sediments; estimation of sediment budget for McNary Reservoir. Expertise: fish habitat carrying capacity; cumulative effects; watershed classification; fish ecology; water temperature effects on the survival and growth of all life stages of salmonids; development of model of fish habitat quality/fish survival; salmon habitat and water quality in relation to fish production; habitat standards; bioenergetics; aquatic invertebrates. Recent/relevant publications/job completions:

McCullough, D.A. and F.A. Espinosa, Jr. 1996. A monitoring strategy for application to salmon-bearing watersheds. Tech. Report 96-5. Columbia River Inter-Tribal Fish Commission, Portland, Oregon. 170 p. + appendices.

Rhodes, J.J., D.A. McCullough, and F.A. Espinosa, Jr. 1994. A coarse screening process for evaluation of the effects of land management activities on salmon spawning and rearing habitat in ESA consultations. Tech. Report 94-4. Columbia River Inter-Tribal Fish Commission, Portland, Oregon. 127 pp. + appendices.

Cuenco, M.L. and D.A McCullough. 1995. Framework for estimating salmon survival as a function of habitat condition. Tech. Report 96-4. Columbia River Inter-Tribal Fish Commission, Portland, Oregon. 107 pp. + appendices.

Espinosa, F.A., Jr., J.J. Rhodes, and D.A. McCullough. 1997. The failure of existing plans to protect salmon habitat on the Clearwater National Forest in Idaho. J. Env. Management 49(2):205-230.

McCullough, D.A. 1998. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to chinook salmon. Prepared for the USEPA, Region 10, Seattle, Washington. 198 p.

Jon Rhodes, Hydrologist, Columbia River Inter-Tribal Fish Commission (CRITFC), Project FTE: 0.4. Project Duties: Co-project leader, coordination, technical analysis, report writing. Education: B.S. Hydrology and Water Resources (Univ. of Arizona, 1981); M.S. Hydrogeology (Univ. of Nev.-Reno, 1985); Ph.D. candidacy degree Forest Hydrology (Univ. of Wash., 1989). Certification status: None. Current Employer: CRITFC (4/89-present). Current Responsibilities: Analysis of direct and cumulative effects of land-use on salmon habitat, channel morphology, water quality, and watershed processes. Provide scientific input as a member of numerous policy and technical forums dealing with aquatic issues, including forest practices and water quality monitoring programs. Recent Previous Employment: Research Assistant, Univ. of Wash. (11/88-4/89, 8/84-6/87); Consulting Hydrologist, Tahoe Regional Planning Assoc. (5-10/88, 7-10/87); Hydrologic Tech., USGS (10/83-6/84). Expertise: General watershed hydrology, water quality, direct and cumulative effects of land-use on aquatic resources, monitoring non-point source pollution, water temperature alteration, sedimentation, analysis of water quality data. Recent/relevant publications/job completions: 1) Co-author with eight others: 1992. The Upper Grande Ronde River Anadromous Fish Habitat Protection, Restoration and Monitoring Plan; 2) A Coarse Screening Process for Evaluation of the Effects of Land Management Activities on Salmon Spawning and Rearing Habitat in ESA Consultations. CRITFC Tech. Rept. 94-4, Portland, Or.--developed under contract with NMFS; 3) 1995. A Comparison and Evaluation of Existing Land Management Plans Affect Spawning and Rearing Habitat of Snake River Basin Salmon Species Listed Under the Endangered Species Act, CRITFC, Portland, Or, unpub. (1995)--developed under contract with NMFS; 4) Espinosa, F.A., Rhodes, J.J., and McCullough, D. A. 1997. The failure of existing plans to protect salmon habitat on the Clearwater National Forest in Idaho. J. Env. Management **49**: 205-230; 5) Rhodes, J.J. and Purser, M.D., *in press*. Overwinter sedimentation of clean gravels in simulated redds in the upper Grande Ronde River and nearby streams in northeastern Oregon, USA: Implications for the survival of threatened spring chinook salmon, Proceedings of Forest-Fish Conference: Land Management Affecting Aquatic Ecosystems, Calgary, Alberta, Canada, May, 1996.

Section 10. Information/technology transfer

The technical information produced in this report will be made available in the form of a report. Results will also be presented orally to the public. In the course of development of the conceptual basis, procedures, framework, and related methodologies, key personnel will interact with regional professionals involved in aspects of watershed analysis, ecosystem management, monitoring, ecosystem modeling. This will be useful in development of a product that would gain acceptance in the Columbia Basin for salmon restoration and would also provide pre-notification of its development. With the increased interest in doing watershed analysis for purposes of subbasin and project planning, we would offer this as a potential tool for the Region to use and would seek external scientific discussion of its merits or weaknesses.